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In situ denitrification rates in shallow groundwater beneath a spring barley - mustard cover crop system

Mohammad Mofizur Rahman Jahangir (1,2), Eddy Minet (2), Paul Johnston (1), Catherine Coxon (3), and Karl Richards (2)

(1) Univerity of Dublin-Trinity College, Department of Civil, Structural & Environmental Engineering, Dublin, Ireland (jahangim@tcd.ie), (2) Teagasc Environment Research Centre, (3) University of Dublin-Trinity College, School of Natural Science

Mustard catch crop has been reported to increase dissolved organic carbon (DOC) concentrations in groundwater, which can be used as an energy source for denitrifiers. This study investigates the impact of a mustard catch crop on in situ denitrification and nitrous oxide (N2O) emissions from an aquifer overlain by arable land. Denitrification rates and N2O-N/(N2O-N+N2-N) mole fractions were measured in situ with a push-pull method in shallow groundwater under a spring barley system in experimental plots with an without a mustard cover crop. The results suggest that a mustard cover crop could substantially enhance reduction of groundwater nitrate (NO_3–N) via denitrification without significantly increasing N2O emissions. Mean total denitrification (TDN) rates below mustard cover crop and no cover crop were 7.61 and 0.002 μg kg-1 d-1, respectively. Estimated N2O-N/(N2O-N+N2-N) ratios, being 0.001 and 1.0 below mustard cover crop and no cover crop respectively, indicate that denitrification below mustard cover crop reduces N2O to N2, unlike the plot with no cover crop. The observed enhanced denitrification under the mustard cover crop may result from the higher groundwater DOC under mustard cover crop (1.53 mg L-1) than no cover crop (0.90 mg L-1) being added by the root exudates and root masses of mustard. This study gives insights into the missing piece in agricultural nitrogen (N) balance and groundwater derived N2O emissions under arable land.